

FORM PTO-1390 (Modified)
(REV 11-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

112740-333

TRANSMITTAL LETTER TO THE UNITED STATES

DESIGNATED/ELECTED OFFICE (DO/EO/US)

CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/980511

INTERNATIONAL APPLICATION NO.

PCT/DE00/01248

INTERNATIONAL FILING DATE

20 April 2000

PRIORITY DATE CLAIMED

27 April 1999

TITLE OF INVENTION

MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

APPLICANT(S) FOR DO/EO/US

Volker Detering et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
 - ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
 - ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
 - ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
 - ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☒ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information:

U.S. APPLICATION NO. **09/980511** SEE 37 CFR

INTERNATIONAL APPLICATION NO.

ATTORNEY'S DOCKET NUMBER

PCT/DE00/01248

112740-333

24. The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **\$1040.00**
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **\$890.00**
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **\$740.00**
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **\$710.00**
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **\$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS PTO USE ONLY

\$890.00

Surcharge of **\$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	12 - 20 =	0	x \$18.00
Independent claims	1 - 3 =	0	x \$84.00
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>

\$0.00

TOTAL OF ABOVE CALCULATIONS =

\$890.00

☒ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.

\$0.00

SUBTOTAL =

\$890.00

Processing fee of **\$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).

\$0.00

TOTAL NATIONAL FEE =

\$890.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

\$0.00

TOTAL FEES ENCLOSED =

\$890.00

Amount to be:
refunded \$
charged \$

- a. ☒ A check in the amount of **\$890.00** to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-1818**. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

William E. Vaughan (Reg. No. 39,056)
Bell, Boyd & Lloyd LLC
P.O. Box 1135
Chicago, Illinois 60690-1135
(312) 807-4292

SIGNATURE

William E. Vaughan

NAME

39,056

REGISTRATION NUMBER

October 24, 2001

DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

5 **PRELIMINARY AMENDMENT**

APPLICANTS: Volker Detering et al. DOCKET NO: 112740-333

SERIAL NO: GROUP ART UNIT:

EXAMINER:

INTERNATIONAL APPLICATION NO: PCT/DE00/01248

10 INTERNATIONAL FILING DATE: 20 April 2000

INVENTION: MOBILE RADIO TRANSCEIVER DEVICE WITH
TUNABLE ANTENNA

15 Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry
into the National stage before the U.S. Patent and Trademark Office under 35
20 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the
Abstract, with the following Substitute Specification:

SPECIFICATION

25 TITLE OF THE INVENTION

MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

BACKGROUND OF THE INVENTION

In radio communication systems, messages (for example, voice, image
information or other data) are transmitted with the aid of electromagnetic waves.
30 The electromagnetic waves are radiated by antennas and the carrier frequencies are
within the frequency band provided for the respective system.

09/980511-102401
T04201-1508550

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for transmitting/receiving capability in different frequency bands. For this reason, antennas are needed which can be used in a number of frequency bands.

5 The demanded coverage of the greatest possible frequency range or, respectively, a number of frequency bands cannot be ensured via conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a function of frequency. This results in a greatly varying antenna gain so that the antenna cannot be used in
10 certain frequency ranges.

For this reason, antenna systems which consist of a number of antennas, each of which covers a certain frequency range, previously have been used for solving this problem.

15 The disadvantageous factor in such antenna systems is, on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which is variable and which also has the ability to adjust the antenna length and to detect
20 the field strength of a received signal. Furthermore, the detection portion is connected to a control device which, in dependence on the field strength, generates a control signal which varies the antenna length via the adjusting portion until an optimum in the field strength is achieved.

25 An object to which the present invention is directed is to develop a mobile radio transceiver device in such a manner that it ensures a uniform stable antenna gain while covering a large frequency range.

SUMMARY OF THE INVENTION

The mobile radio transceiver device according to the present invention, therefore, includes:

- an antenna, the length of which can be changed and which is provided for transmitting and receiving radio signals of different frequencies or, respectively, the corresponding wavelengths within a large frequency range;
- 5 • a part (facility) for adjusting the antenna length;
- a part for detecting at least one physical input variable representing a function of the antenna length; and
- a control device which reads in at least one input variable and generates, in dependence on this input variable, at least one output signal (control signal) by which the part for adjusting the antenna length is driven, until the antenna length is adjusted to one quarter of the wavelength by the adjusting part.
- 10

An advantage of the mobile radio transceiver device according to the present invention is a stable antenna gain which is ensured by matching the antenna length to a quarter of the wavelength of the current frequency independently of the magnitude of the frequency range within which the mobile radio transceiver device is used.

- 15

An advantage of one embodiment of the present invention is the detection and the directed transmitting power of the radio signal which provide for simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

- 20

An advantage of a further embodiment is the detection and conditioning, required for digital signal processing, of the antenna impedance which provides for a simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

- 25

An advantage of yet another embodiment is the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention.

An advantage of one more embodiment is the possibility to be able to use materials which do not need to exhibit any special rigidity but only high resistance to tearing and flexibility for the wire for telescoping the antenna in and out.

Advantages of further embodiments are the simple implementation of the
5 length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention and the greater attraction for the purchaser or user by hiding the change in antenna length via an electrically nonconductive hollow body.

An advantage of another embodiment is the implementation of a simple
10 device for adjusting the antenna length, which only needs a control signal.

An advantage of yet another embodiment is the implementation of a simple adjusting part for the antenna length which only needs a control signal, the adjustment taking place in defined steps (increments).

Advantages of other embodiments are flexibility and the possibility for
15 updating the implementation of the control which is made possible by using (control) software, and the possibility of using preexisting processors for controlling the mobile radio transceiver device according to the present invention by using additional software or adapting the existing software.

Yet additional advantages are obtained in an embodiment such as the simple
20 and advantageous implementation of the control unit and the possibility of implementing this switching network as integrated circuit in an expansion chip.

The advantages of a further embodiment are the advantageous material properties - high flexibility with high rigidity - of nylon.

An advantage of one further embodiment is that it makes possible to use the
25 mobile radio transceiver device in a frequency range in which the ratio between the highest frequency and the lowest frequency is at least 1.5 octaves.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a mobile radio transceiver device with a telescopic antenna which can be telescoped in and out via a controlled electric motor.

Figure 2 shows a mobile radio transceiver device with a wire antenna which
5 can be telescoped in and out - guided by a hollow body – via an electric motor.

Figure 3 shows a mobile radio transceiver device with adjustment of the antenna length which depends on the upward directed and/or downward directed transmitting power.

Figure 4 shows a mobile radio transceiver device with an adjustment of the
10 antenna length which depends on the antenna impedance.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{\min} from the point of view of radio engineering of the
15 telescopic antenna ANT1 being determined by the length of an outermost telescopic segment and a maximum effective antenna length l_{\max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an electrically nonconductive wire D1, for example a nylon wire, is attached to its
20 point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the characteristics
25 described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{\max} of the telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now
30 additionally only needs to exhibit sufficient (tearing) strength and flexibility.

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example, as a stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts the rotation of the coil former SP1 into a straight-line movement and, thus, enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) μP , the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit μP .

The control unit μP controls the electric motor VM via the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency.

The control unit μP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The coil former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves. Otherwise, the case may occur that the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT} . This value of

antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case, but an objective of the present invention is not achieved at this value of antenna length l_{ANT} . Ending of the control operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control

5 software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit μP receives the input variable EG, which may be

10 conditioned, from part EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit μP by this part (compare Figures 3 and 4).

As an alternative, the part EFM also detects a number of physical input variables EG and may condition these before they are forwarded to the control unit

15 μP , the control unit μP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which

20 from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully telescoped wire D2.

The electrically conductive wire D2 is guided by an electrically

25 nonconductive rotationally symmetric hollow body HK which is closed at one end, during retraction and telescoping out.

The minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering of the wire antenna ANT2 is obtained from the diameter of the coil former SP2 and the distance between coil former SP2 and the open end of the

30 hollow body HK through which the electrically conductive wire D2 must pass. The

maximum effective antenna length $l_{ANT,max}$ from the point of view of radio engineering is obtained from the diameter of the coil former SP2 and the distance between the coil former SP2 and the closed end of the hollow body HK through which the electrically conductive wire D2 must pass.

5 The antenna length l_{ANT} is controlled, for example, by the components known from Figure 1:

Part EFM for detecting and conditioning physical input variables EG depending on the antenna length l_{ANT} ; control unit μP for evaluating the input variables EG and generating the corresponding control signal U_{ST} for driving the
10 electric motor VM which correspondingly rotates the coil former SP2 in one direction; and the wire D2 guided through the hollow body HK converting the rotational movement of the coil former SP2 into a straight-line movement.

The hollow body HK additionally fulfills the function of hiding the wire antenna ANT2; i.e., the movement of the wire D2 resulting from the antenna length
15 l_{ANT} being controlled. It is not visible to the user, which increases the attraction of the mobile radio transceiver device SE. In addition, the hollow body HK protects the wire D2 against deformations.

The antenna connection of the wire antenna D2 is implemented by a sliding contact SK which is in contact with the electrically conductive coil former SP2 and,
20 as an alternative, the sliding contact SK can also contact the electrically conductive wire D2 wound on to the coil former SP2.

Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting part VM for adjusting the antenna length l_{ANT} , the control unit μP and part EFM for
25 detecting a transmit signal SIG which is generated by a radio section FT.

For this purpose, the part EFM exhibits a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a
30 first digital signal P_V'' by a first analog/digital converter AD1. The return transmit

power P_R is rectified by a second rectifier G2 and the rectified return transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

5 The digital signals P_V'' , P_R'' are present as input signal at the control unit μP , the control unit μP being constructed, for example, as (micro)processor with associated software. With the signals P_V'' , P_R'' present, the processor μP checks whether the signals P_V'' , P_R'' have, in each case, reached an ideal value $P_R''=0$ or $P_R''=P_{R,min}''$ and $P_V''=P_{V,max}''$.

10 If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor μP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals P_V'' , P_R'' present at the processor which are changed by this process are checked by the
15 processor μP with respect to the ideal values to be reached.

If the values of the signals P_V'' , P_R'' have deteriorated with regard to reaching the ideal values, the direction of rotation of the part (VM) for adjusting the antenna length l_{ANT} is changed. This is achieved, for example, by reversing the sign of the signal U_{ST} .

20 Following the determination of the correct direction, the signal U_{ST} is generated until the input signals P_V'' , P_R'' have reached their ideal values.

As an alternative, any one of the two variables - forward transmit power P_V and return transmit power P_R - can also be used as control variable for this servo loop; i.e., detected by the part EFM and checked by the processor μP whether it has
25 reached the ideal values (minimum or no return transmit power or maximum forward transmit power).

As an alternative to using an additional processor μP , it would be conceivable that pre-existing processors are updated by suitable control software in order to be able to perform this control operation.

If an additional processor μP is used, it would also be conceivable to integrate the part EFM in the processor μP .

The radio transceiver device SE shown in Figure 4 again exhibits the part EFM for detecting the current antenna impedance Z_{ANT} of the antenna ANT.

5 For this purpose, the part EFM is constructed as a Wheatstone resistance measuring bridge, with a reference resistor $R_0=50\Omega$, two resistors R_1, R_2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating noise; for example, implemented by a diode connected to a direct-voltage source. A current bridge voltage U_{BR} present at
10 terminals KL is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' via an analog/digital converter AD3.

The signal U_{BR}'' is forwarded to a control unit μP which, when a signal is present, starts to control the antenna length l_{ANT} , which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the
15 antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} (i.e., whether the antenna is to be retracted or telescoped out) being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit μP as
20 switchgear and to implement it as an integrated circuit in a special expansion chip.

A first exemplary embodiment of the present invention is obtained by combining Figures 1 and 3, a second exemplary embodiment is obtained from Figures 1 and 4, a third exemplary embodiment is obtained from Figures 2 and 3 and a fourth one from Figures 2 and 4.

25 The four exemplary embodiments only represent a part of the embodiments possible pursuant to the present invention. Thus, an expert active in this field is capable of creating a multiplicity of further embodiments via advantageous modifications without changing the character (nature) of the present invention. These embodiments are also intended to be covered by the present invention.

Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

To implement a transmitting/receiving capability in different frequency ranges via radio transceiver devices which guarantee a uniformly stable antenna gain, the radio transceiver devices are equipped with an antenna, the length of which is adjustable, the antenna length being changed by an adjusting part controlled by a control device. The control device controls the adjusting part in dependence on physical input variables representing the antenna length until the antenna length corresponds to one quarter of the wavelength.

In the claims:

On page 12, cancel line 1, and substitute the following left-hand justified heading therefor:

CLAIMS

Please cancel claims 1-12, without prejudice, and substitute the following claims therefor:

13. A mobile radio transceiver device, comprising:
- an antenna for transmitting radio signals of different wavelengths, the length of the antenna being variable;
 - an adjusting part for adjusting the antenna length;
 - a detection part for detecting at least one physical input variable representing a function of the antenna length; and
 - a control device connected to the detection part for controlling the adjusting part via at least one control signal in dependence on the at least physical input variable until the antenna length is adjusted to one quarter of the wavelength via the adjusting part, the control device adjusting the antenna length to a minimum value at a beginning of the adjustment of the antenna length.

14. A mobile radio transceiver device as claimed in claim 13, wherein the detection part further comprises:

a directional coupler for measuring at least one of a forward transmit power and a return transmit power of a transmit signal;

5 at least one rectifier for rectifying values of the forward transmit power and the return transmit power measured by the directional coupler, the at least one rectifier generating, respectively, a rectified forward transmit power and a rectified return transmit power; and

10 at least one A/D converter for digital conversion of the rectified values of the forward transmit power and the return transmit power, the at least one A/D converter generating, respectively, a digitally converted forward transmit power and a digitally converted return transmit power;

15 wherein the control device reads in the digitally converted values of the forward transmit power and the return transmit power as input signals and generates the control signal dependent thereupon until, respectively, a value of the digitally converted forward transmit power is at a maximum and a value of the digitally converted return transmit power is at a minimum.

15. A mobile radio transceiver device as claimed in claim 13, wherein the detection part further comprises:

a Wheatstone measuring bridge which generates a bridge voltage which is proportional to an impedance of the antenna;

a noise generator used as an input signal source for the Wheatstone measuring bridge;

25 a rectifier for rectifying the bridge voltage of the Wheatstone measuring bridge to generate a rectified bridge voltage; and

an A/D converter for digital conversion of the rectified value of the bridge voltage of the Wheatstone measuring bridge, the A/D converter generating a digitally converted bridge voltage;

wherein the control unit, which reads in the digitally converted value of the bridge voltage of the Wheatstone measuring bridge as input signal, generates a control signal dependent thereupon until the Wheatstone measuring bridge is calibrated.

5

16. The mobile radio transceiver device as claimed in Claim 13, wherein the antenna is a telescopic antenna to which an electrically non-conductive wire is attached on an inside surface at an antenna point, the adjusting part exhibits an electrically non-conductive coil former on which the electrically non-conductive wire is wound, and the electrically non-conductive wire converts rotational movement of the coil former into a straight-line movement in order to retract and telescope out the telescopic segments of the telescopic antenna.

17. A mobile radio transceiver device as claimed in Claim 16, wherein the telescopic antenna further comprises:

a spring, for supporting the wire for telescoping out the telescopic antenna, which presses all telescopic segments of the telescopic antenna outward so that the telescopic antenna is completely telescoped out.

18. A mobile radio transceiver device as claimed in Claim 13, wherein the the adjusting part includes an electrically conductive coil former on which an electrically conductive wire, electrically conductively connected to the coil former, is wound, the electrically conductive wire converts a rotational movement of the coil former, guided by an electrically non-conductive hollow body, into a straight-line movement, and the antenna is constructed as a wire antenna which is composed of the telescoped-out wire and the electrically conductively connected coil former , a connection of the wire antenna being achieved via an electrically conductive sliding contact which contacts the coil former at a base.

19. A mobile radio transceiver device as claimed in Claim 13, wherein the adjusting part includes an electrically conductive coil former on which an electrically conductive wire, electrically conductively connected to the coil former, is wound, the electrically conductive wire converts a rotational movement of the coil former, guided by an electrically non-conductive hollow body, into a straight-line movement, and the antenna is constructed as wire antenna which is composed of the telescoped-out wire and the electrically conductively connected coil former, a connection of the wire antenna being achieved via an electrically conductive sliding contact which contacts the wire wound onto the coil former at a base.

10

20. A mobile radio transceiver device as claimed in Claim 13, wherein the adjusting device is an electric motor.

21. A mobile radio transceiver device as claimed in Claim 20, wherein the electric motor is a stepping motor.

15

22. A mobile radio transceiver device as claimed in Claim 13, wherein the control unit is a processor with software designed for generating the at least one control signal.

20

23. A mobile radio transceiver device as claimed in Claim 13, wherein the control unit is switchgear.

24. A mobile radio transceiver device as claimed in Claim 16, wherein the electrically non-conductive wire is a nylon wire.

25

REMARKS

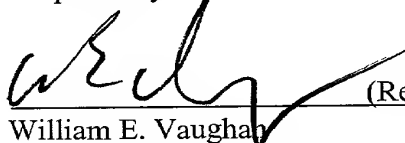
The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is

added thereby. Attached hereto is a marked-up version of the changes made to the specification by the present amendment. The attached page is captioned "Version With Markings To Show Changes Made".

5 In addition, the present amendment cancels original claims 1-12 in favor of
new claims 13-24. Claims 13-24 have been presented solely because the revisions
by crossing out and underlining which would have been necessary in claims 1-12 in
order to present those claims in accordance with preferred United States Patent
Practice would have been too extensive, and thus would have been too burdensome.
The present amendment is intended for clarification purposes only and not for
10 substantial reasons related to patentability pursuant to 35 U.S.C. §§103, 102, 103 or
112. Indeed, the cancellation of claims 1-12 does not constitute an intent on the
part of the Applicants to surrender any of the subject matter of claims 1-12.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

15  (Reg. No. 39,056)

William E. Vaughan
Bell, Boyd & Lloyd LLC
P.O. Box 1135
Chicago, Illinois 60690-1135
20 (312) 807-4292
Attorneys for Applicant

Version With Markings to Show Changes Made

Description

SPECIFICATION

TITLE OF THE INVENTION

5 ~~Mobile radio transceiver device with tunable antenna~~

MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

BACKGROUND OF THE INVENTION

In radio communication systems, messages (for example, voice, image information or other data) are transmitted with the aid of electromagnetic waves.

10 The electromagnetic waves are radiated by antennas and the carrier frequencies are within the frequency band provided for the respective system.

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for transmitting/receiving capability in different frequency bands. For this reason,
15 antennas are needed which can be used in a number of frequency bands.

The demanded coverage of the greatest possible frequency range or, respectively, a number of frequency bands cannot be ensured ~~by means of~~ via conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a
20 function of frequency, ~~which.~~ This results in a greatly varying antenna gain so that the antenna cannot be used in certain frequency ranges.

For this reason, antenna systems which consist of a number of antennas, each of which covers a certain frequency range, ~~have previously~~ have been used for solving this problem.

25 The disadvantageous factor in such antenna systems is, on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which
30 is variable and which also has ~~means for adjusting~~ the ability to adjust the antenna

length and ~~means for detecting~~ to detect the field strength of a received signal.
Furthermore, the detection ~~means are~~ portion is connected to a control device
which, in dependence on the field strength, generates a control signal which varies
the antenna length ~~by means of~~ via the adjusting ~~means~~ portion until an optimum in
5 the field strength is achieved.

The An object ~~forming to which~~ the ~~basis of the~~ present invention is
directed is to develop a mobile radio transceiver device in such a manner that it
ensures a uniform stable antenna gain ~~whilst~~ while covering a large frequency
range.

10 ~~This object is achieved by features of claim 1.~~

SUMMARY OF THE INVENTION

The mobile radio transceiver device according to the present invention
~~according to claim 1 exhibits, therefore, includes:~~

- 15 • an antenna, the length of which can be changed and which is provided
for transmitting and receiving radio signals of different frequencies or,
respectively, the corresponding wavelengths within a large frequency
range;
- a ~~means~~ part (facility) for adjusting the antenna length;
- ~~means a part~~ for detecting at least one physical input variable
20 representing a function of the antenna length; and
- a control device ~~connected to the means~~, which reads in at least one
input variable and generates, in dependence on this input variable, at
least one output signal (control signal) by ~~means of~~ which the ~~means~~
part for adjusting the antenna length ~~are~~ is driven, until the antenna
25 length is adjusted to one quarter of the wavelength by the adjusting
~~means; part.~~

The ~~essential~~ An advantage of the mobile radio transceiver device according
to the present invention is a stable antenna gain which is ensured by matching the
antenna length to a quarter of the wavelength of the current frequency

independently of the magnitude of the frequency range within which the mobile radio transceiver device is used.

5 An essential advantage of ~~the further development according to claim 2~~ one embodiment of the present invention is the detection and the directed transmitting power of the radio signal which provide for simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

10 An essential advantage of ~~the a further development according to claim 3~~ embodiment is the detection and conditioning, required for digital signal processing, of the antenna impedance which provides for a simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

~~The essential~~ An advantage of ~~the further development according to claim 4~~ yet another embodiment is the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention.

15 ~~The essential~~ An advantage of ~~the further development according to claim 5~~ one more embodiment is the possibility to be able to also use materials which do not need to exhibit any special rigidity but only high resistance to tearing and flexibility for the wire for telescoping the antenna in and out.

20 Advantages of ~~the further developments according to claim 6 and 7~~ further embodiments are the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention and the greater attraction for the purchaser or user by hiding the change in antenna length ~~by means of~~ via an electrically nonconductive hollow body.

25 An essential advantage of ~~the further development according to claim 8~~ another embodiment is the implementation of a simple device for adjusting the antenna length, which only needs a control signal.

30 An essential advantage of ~~the further development according to claim 9~~ yet another embodiment is the implementation of a simple adjusting ~~means~~ part for the antenna length which only ~~need~~ needs a control signal, the adjustment taking place in defined steps (increments).

Essential advantages of the further development according to claim 10
Advantages of other embodiments are flexibility and the possibility for updating the
implementation of the control which is made possible by using (control) software,
and the possibility of using preexisting processors for controlling the mobile radio
transceiver device according to the present invention by using additional software
or adapting the existing software.

Essential advantages of the further development according to claim 11 are
Yet additional advantages are obtained in an embodiment such as the simple and
advantageous implementation of the control unit and the possibility of
implementing this switching network as integrated circuit in an expansion chip.

The essential advantages of the a further development according to claim 12
embodiment are the advantageous material properties - high flexibility with high
rigidity - of nylon.

The essential An advantage of the one further development according to
claim 13 embodiment is that it makes possible to use the mobile radio transceiver
device in a frequency range in which the ratio between the highest frequency and
the lowest frequency is at least 1.5 octaves.

Additional features and advantages of the present invention are described in,
and will be apparent from, the following Detailed Description of the Invention and
the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Exemplary embodiments of the invention will be explained with reference to the
figures 1 to 4, in which:

Figure 1 shows a mobile radio transceiver device with a telescopic antenna
which can be telescoped in and out by means of via a controlled electric motor,

Figure 2 shows a mobile radio transceiver device with a wire antenna which
can be telescoped in and out - guided by a hollow body - by means of via an
electric motor,

Figure 3 shows a mobile radio transceiver device with adjustment of the antenna length which depends on the upward directed and/or downward directed transmitting power.

Figure 4 shows a mobile radio transceiver device with an adjustment of the antenna length which depends on the antenna impedance.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{\min} from the point of view of radio engineering of the telescopic antenna ANT1 being determined by the length of an outermost telescopic segment and a maximum effective antenna length l_{\max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an electrically nonconductive wire D1, for example a nylon wire, is attached to its point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the characteristics described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{\max} of the telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now additionally only needs to exhibit sufficient (tearing) strength and flexibility.

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example, as a stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts

the rotation of the coil former SP1 into a straight-line movement and, thus, enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) μP , the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit μP .

The control unit μP controls the electric motor VM ~~by means of~~ via the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency. The control unit μP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The core former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves; ~~since otherwise.~~ Otherwise, the case may occur that the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT} . This value of antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case, but ~~the object~~ an objective of the present invention is not achieved at this value of antenna length l_{ANT} . Ending of the control

operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit μP receives the input variable EG, which may be conditioned, from ~~means part~~ EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit μP by ~~these means~~ this part (compare figure 3 Figures 3 and 4).

As an alternative, the ~~means part~~ EFM also ~~deteet~~ detects a number of physical input variables EG and may condition these before they are forwarded to the control unit μP , the control unit μP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully telescoped wire D2.

The electrically conductive wire D2 is guided by an electrically nonconductive rotationally symmetric hollow body HK which is closed at one end, during retraction and telescoping out.

The minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering of the wire antenna ANT2 is obtained from the diameter of the coil former SP2 and the distance between coil former SP2 and the open end of the hollow body HK through which the electrically conductive wire D2 must pass. The maximum effective antenna length $l_{ANT,max}$ from the point of view of radio engineering is obtained from the diameter of the coil former SP2 and the distance

between the coil former SP2 and the closed end of the hollow body HK through which the electrically conductive wire D2 must pass.

The antenna length l_{ANT} is controlled, for example, by the components known from ~~figure 1~~: Figure 1:

5 ~~Means Part~~ Part EFM for detecting and conditioning physical input variables EG depending on the antenna length l_{ANT} ; control unit μP for evaluating the input variables EG and generating the corresponding control signal U_{ST} for driving the electric motor VM which correspondingly rotates the coil former SP2 in one direction; and the wire D2 guided through the hollow body HK converting the
10 rotational movement of the coil former SP2 into a straight-line movement.

The hollow body HK additionally fulfills the function of hiding the wire antenna ANT2; i.e., the movement of the wire D2 resulting from the antenna length l_{ANT} being controlled; ~~it~~. It is not visible to the user, which increases the attraction of the mobile radio transceiver device SE. In addition, the hollow body
15 HK protects the wire D2 against deformations.

The antenna connection of the wire antenna D2 is implemented by a sliding contact SK which is in contact with the electrically conductive coil former SP2 and, as an alternative, the sliding contact SK can also contact the electrically conductive wire D2 wound on to the coil former SP2.

20 Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting ~~means part~~ part VM for adjusting the antenna length l_{ANT} , the control unit μP and ~~means part~~ part EFM for detecting a transmit signal SIG which is generated by a radio section FT.

25 For this purpose, the ~~means part~~ part EFM ~~exhibit~~ exhibits a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a first digital signal P_V'' by a first analog/digital converter AD1. The return
30 transmit power P_R is rectified by a second rectifier G2 and the rectified return

transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

The digital signals P_V'' , P_R'' are present as input signal at the control unit μP , the control unit μP being constructed, for example, as (micro)processor with associated software. With the signals P_V'' , P_R'' present, the processor μP checks whether the signals P_V'' , P_R'' have, in each case, reached an ideal value $P_R''=0$ or $P_R''=P_{R,min}''$ and $P_V''=P_{V,max}''$.

If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor μP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals P_V'' , P_R'' present at the processor which are changed by this process are checked by the processor μP with respect to the ideal values to be reached.

If the values of the signals P_V'' , P_R'' have deteriorated with regard to reaching the ideal values, the direction of rotation of the means part (VM) for adjusting the antenna length l_{ANT} is changed. This is achieved, for example, by reversing the sign of the signal U_{ST} .

Following the determination of the correct direction, the signal U_{ST} is generated until the input signals P_V'' , P_R'' have reached their ideal values.

As an alternative, any one of the two variables - forward transmit power P_V and return transmit power P_R - can also be used as control variable for this servo loop; i.e., detected by the means part EFM and checked by the processor μP whether it has reached the ideal values -(minimum or no return transmit power or maximum forward transmit power).

As an alternative to using an additional processor μP , it would be conceivable that pre-existing processors are updated by suitable control software in order to be able to perform this control operation.

If an additional processor μP is used, it would also be conceivable to integrate the means part EFM in the processor μP .

099054-102401
101201-1150350

The radio transceiver device SE shown in ~~figure~~ Figure 4 again exhibits the ~~means part~~ EFM for detecting the current antenna impedance Z_{ANT} of the antenna ANT.

For this purpose, the ~~means part~~ EFM ~~are~~ is constructed as a Wheatstone resistance measuring bridge, with a reference resistor $R_0=50\Omega$, two resistors R_1 , R_2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating noise; for example, implemented by a diode connected to a direct-voltage source. A current bridge voltage U_{BR} present at terminals KL is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' ~~by means of~~ via an analog/digital converter AD3.

The signal U_{BR}'' is forwarded to a control unit μP which, when a signal is present, starts to control the antenna length l_{ANT} , which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} ~~-i.e. (i.e.,~~ whether the antenna is to be retracted or telescoped out-) being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit μP as switchgear and to implement it as an integrated circuit in a special expansion chip.

A first exemplary embodiment of the present invention is obtained by combining ~~figures~~ Figures 1 and 3, a second exemplary embodiment is obtained from ~~figures~~ Figures 1 and 4, a third exemplary embodiment is obtained from ~~figures~~ Figures 2 and 3 and a fourth one from ~~figures~~ Figures 2 and 4.

The said four exemplary embodiments only represent a part of the embodiments possible ~~by means of~~ pursuant to the present invention. Thus, an expert active in this field is capable of creating a multiplicity of further embodiments ~~by means of~~ via advantageous modifications without changing the

character (nature) of the present invention ~~by this means~~. These embodiments are also intended to be covered by the ~~invention~~. present invention.

Patent Claims

- 5 Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

Abstract

ABSTRACT OF THE DISCLOSURE

~~Mobile radio transceiver device with tuneable antenna~~

5 To implement a transmitting/receiving capability in different frequency
ranges ~~via by means of~~ radio transceiver devices ~~SE~~ which guarantee a uniformly
stable antenna gain, the radio transceiver devices ~~SE~~ are equipped with an antenna
~~ANT~~, the length l_{ANT} of which is adjustable, the antenna length l_{ANT} being changed
by ~~an means of adjusting part means VM~~ controlled by ~~means of~~ a control device
10 μP . The control device μP controls the adjusting ~~part means VM~~ in dependence on
physical input variables ~~EG~~ representing the antenna length l_{ANT} until the antenna
length l_{ANT} corresponds to one quarter of the wavelength $\lambda/4$.

~~FIGURE 3~~

15

4/PP2 TS

09/980511

GR 99 P 1729

JC10 Rec'd PCT/PTO 2 4 NOV 2001

Description

Mobile radio transceiver device with tunable antenna

5 In radio communication systems, messages (for example voice, image information or other data) are transmitted with the aid of electromagnetic waves. The electromagnetic waves are radiated by antennas and the carrier frequencies are within the frequency band
10 provided for the respective system.

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for
15 transmitting/receiving capability in different frequency bands. For this reason, antennas are needed which can be used in a number of frequency bands.

The demanded coverage of the greatest possible
20 frequency range or, respectively, a number of frequency bands cannot be ensured by means of conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a function
25 of frequency, which results in a greatly varying antenna gain so that the antenna cannot be used in certain frequency ranges.

For this reason, antenna systems which consist of a
30 number of antennas, each of which covers a certain frequency range, have previously been used for solving this problem.

The disadvantageous factor in such antenna systems is,
35 on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

09980511-102404

From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which is variable and which also has means for adjusting the antenna length and means for detecting the field strength of a received signal. Furthermore, the detection means are connected to a control device which, in dependence on the field strength, generates a control signal which varies the antenna length by means of the adjusting means until an optimum in the field strength is achieved.

The object forming the basis of the invention is to develop a mobile radio transceiver device in such a manner that it ensures a uniform stable antenna gain whilst covering a large frequency range.

This object is achieved by features of claim 1.

- 20 The mobile radio transceiver device according to the invention according to claim 1 exhibits
- an antenna, the length of which can be changed and which is provided for transmitting and receiving radio signals of different frequencies or, respectively, the corresponding wavelengths within a large frequency range,
 - a means (facility) for adjusting the antenna length,
 - means for detecting at least one physical input variable representing a function of the antenna length
 - a control device connected to the means, which reads in at least one input variable and generates, in dependence on this input variable, at least one output signal (control signal) by means of which the means for adjusting the antenna

length are driven, until the antenna length is adjusted to one quarter of the wavelength by the adjusting means.

- 5 The essential advantage of the mobile radio transceiver device according to the invention is a stable antenna gain which is ensured by matching the antenna length to a quarter of the wavelength of the current frequency independently of the magnitude of the frequency range
10 within which the mobile radio transceiver device is used.

An essential advantage of the further development according to claim 2 is the detection and the

GR 99 P 1729

- 2a -

conditioning, required for digital signal processing,
of output and/or downward

09980511 102401

Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

- Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

Figure 1. The 1000 most abundant taxa in the 1000 most abundant taxa list. The taxa are listed in descending order of abundance. The taxa are grouped into 10 categories: Bacteria, Eukarya, Archaea, Fungi, Plantae, Animalia, Protista, Viridiplantae, Chromista, and Eukaryota.

An essential advantage of the further development according to claim 9 is the implementation of simple adjusting means for the antenna length which only need
5 a control signal, the adjustment taking place in defined steps (increments).

090301-102401

Essential advantages of the further development according to claim 10 are flexibility and possibility for updating the implementation of the control which is made possible by using (control) software, and the possibility of using preexisting processors for controlling the mobile radio transceiver device according to the invention by using additional software or adapting the existing software.

Essential advantages of the further development according to claim 11 are the simple and advantageous implementation of the control unit and the possibility of implementing this switching network as integrated circuit in an expansion chip.

The essential advantages of the further development according to claim 12 are the advantageous material properties - high flexibility with high rigidity - of nylon.

The essential advantage of the further development according to claim 13 is that it makes possible to use the mobile radio transceiver device in a frequency range in which the ratio between the highest frequency and the lowest frequency is at least 1.5 octaves.

Exemplary embodiments of the invention will be explained with reference to the figures 1 to 4, in which:

Figure 1 shows a mobile radio transceiver device with a telescopic antenna which can be telescoped in and out by means of a controlled electric motor,

Figure 2 shows a mobile radio transceiver device with a wire antenna which can be telescoped in and out - guided by a hollow body - by means of

- 4a -

an electric motor,

Figure 3 shows a mobile radio transceiver device with
adjustment of the antenna length which
5 depends on the upward directed and/or
downward directed transmitting power,

00000511-102401

Figure 4 shows a mobile radio transceiver device with an adjustment of the antenna length which depends on the antenna impedance.

5 Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{\min} from the point of view of radio engineering of the telescopic antenna ANT1 being determined by the
10 length of an outermost telescopic segment and a maximum effective antenna length l_{\max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an
15 electrically nonconductive wire D1, for example a nylon wire, is attached to its point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically
20 nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the
25 characteristics described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{\max} of the
30 telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now additionally only needs to exhibit sufficient (tearing) strength and flexibility.

35

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example,

- 5a -

as stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts

00000511-102401

the rotation of the coil former SP1 into a straight-line movement and thus enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) μP , the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit μP .

The control unit μP controls the electric motor VM by means of the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency. The control unit μP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The core former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when

the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves, since otherwise the case may occur that

5 the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT} . This value

0909091-102401

of antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case but the object of the invention is not achieved at this value of antenna length l_{ANT} . Ending of the control operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit μP receives the input variable EG, which may be conditioned, from means EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit μP by these means (compare figure 3 and 4).

As an alternative, the means EFM also detect a number of physical input variables EG and may condition these before they are forwarded to the control unit μP , the control unit μP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully

telescoped wire D2.

The electrically conductive wire D2 is guided by an
electrically nonconductive rotationally symmetric
5 hollow body HK which is closed at one end, during
retraction and telescoping out.

09980511-102401

Figure 1 consists of 12 sub-diagrams labeled (a) through (l), arranged vertically. Each diagram shows a cross-section of a magnetic field configuration. The diagrams illustrate the process of magnetic field evolution, including the formation of a magnetic island and the subsequent reconnection process. The diagrams show the magnetic field lines (B) and the current density (j) distribution. The diagrams are labeled (a) through (l) and show the evolution of the magnetic field configuration over time.

Figure 1 consists of 12 sub-diagrams labeled (a) through (l), arranged vertically. Each diagram shows a cross-section of a magnetic field configuration. The diagrams illustrate the process of magnetic field evolution, including the formation of a magnetic island and the subsequent reconnection process. The diagrams show the magnetic field lines (B) and the current density (j) distribution. The diagrams are labeled (a) through (l) and show the evolution of the magnetic field configuration over time.

Figure 1 consists of 12 sub-diagrams labeled (a) through (l), arranged vertically. Each diagram shows a cross-section of a magnetic field configuration. The diagrams illustrate the process of magnetic field evolution, including the formation of a magnetic island and the subsequent reconnection process. The diagrams show the magnetic field lines (B) and the current density (j) distribution. The diagrams are labeled (a) through (l) and show the evolution of the magnetic field configuration over time.

Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting means VM for adjusting the antenna length l_{ANT} , the control unit μP and means EFM for detecting a transmit signal SIG which is generated by a radio section FT.

For this purpose, the means EFM exhibit a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a first digital signal P_V'' by a first analog/digital converter AD1. The return transmit power P_R is rectified by a second rectifier G2 and the rectified return transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

The digital signals P_V'' , P_R'' are present as input signal at the control unit μP , the control unit μP being constructed, for example, as (micro)processor with associated software. With the signals P_V'' , P_R'' present, the processor μP checks whether the signals P_V'' , P_R'' have in each case reached an ideal value $P_R''=0$ or $P_R''=P_{R,min}''$ and $P_V''=P_{V,max}''$.

If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor μP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals

- 9a -

$P_{V''}$, $P_{R''}$ present at the processor which are changed by this process are checked by the processor μP with respect to the ideal values to be reached.

10

15

20

25

30

35

For this purpose, the means EFM are constructed as Wheatstone resistance measuring bridge, with a reference resistor $R_0=50\Omega$, two resistors R_1 , R_2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating

Figure 1 consists of 15 histograms arranged vertically, labeled from $k=0$ at the top to $k=14$ at the bottom. Each histogram shows the frequency of the number of non-zero elements in the first column of the matrix A^k . The x-axis for all histograms ranges from 0 to 100, and the y-axis ranges from 0 to 100. The distributions are as follows:

- $k=0$: A single peak at 50 with a frequency of approximately 100.
- $k=1$: A single peak at 75 with a frequency of approximately 100.
- $k=2$: A single peak at 25 with a frequency of approximately 100.
- $k=3$: A single peak at 75 with a frequency of approximately 100.
- $k=4$: A single peak at 25 with a frequency of approximately 100.
- $k=5$: A single peak at 75 with a frequency of approximately 100.
- $k=6$: A single peak at 25 with a frequency of approximately 100.
- $k=7$: A single peak at 75 with a frequency of approximately 100.
- $k=8$: A single peak at 25 with a frequency of approximately 100.
- $k=9$: A single peak at 75 with a frequency of approximately 100.
- $k=10$: A single peak at 25 with a frequency of approximately 100.
- $k=11$: A single peak at 75 with a frequency of approximately 100.
- $k=12$: A single peak at 25 with a frequency of approximately 100.
- $k=13$: A single peak at 75 with a frequency of approximately 100.
- $k=14$: A single peak at 25 with a frequency of approximately 100.

is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' by means of an analog/digital converter AD3.

5 The signal U_{BR}'' is forwarded to a control unit μP which, when a signal is present, starts to control the antenna length l_{ANT} , which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the antenna length l_{ANT} meets the
10 condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} - i.e. whether the antenna is to be retracted or
15 telescoped out - being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit μP as switchgear and to implement it as an
20 integrated circuit in a special expansion chip.

A first exemplary embodiment of the invention is obtained by combining figures 1 and 3, a second exemplary embodiment is obtained from figures 1 and 4,
25 a third exemplary embodiment is obtained from figures 2 and 3 and a fourth one from figures 2 and 4.

The said four exemplary embodiments only represent a part of the embodiments possible by means of the
30 invention. Thus an expert active in this field is capable of creating a multiplicity of further embodiments by means of advantageous modifications without changing the character (nature) of the invention by this means. These embodiments are also
35 intended to be covered by the invention.

Patent Claims

1. A mobile radio transceiver device (SE) having the following features;

- 5 a) an antenna (ANT) for transmitting radio signals (SIG) of different wavelength (λ), the length of which is variable,
- b) means (VM) for adjusting the antenna length (l_{ANT}),
- 10 c) means (EFM) for detecting at least one physical input variable (EG) representing a function of the antenna length (l_{ANT}),
- d) a control device (μP) connected to the detection means (EFM), which controls the adjusting means (VM) by means of at least one control signal (U_{ST}) in dependence on the input variable (EG) or on the input variables (EG) until the antenna length (l_{ANT}) is adjusted to one quarter of the wavelength (λ) by means of the adjusting means (VM),
- 15 e) the control unit (μP) is constructed in such a manner that it adjusts the antenna length (l_{ANT}) to a minimum value ($l_{ANT, min}$) at the beginning of the adjustment of the antenna length (l_{ANT}).
- 20

2. The mobile radio transceiver device (SE) as claimed in claim 1, characterized in that

25

- a) the detection means (EFM) exhibit a directional coupler (RK) for measuring a forward transmit power (P_V) and/or return transmit power (P_R) of a transmit signal (SIG),
- 30 b) the detection means (EFM) are equipped, for rectifying the values of the forward transmit power (P_V) and/or return transmit power (P_R), measured by the directional coupler (RK), with at least one rectifier (G1, G2) which generates a rectified forward transmit power (P_V') and/or a
- 35 rectified return transmit power (P_R'),

- e) the control unit (μP), which reads in the digitally converted value of the bridge voltage (U_{BR}') of the Wheatstone measuring bridge (WM) as input signal, generates a control

signal (U_{ST}) dependent thereupon until the Wheatstone measuring bridge (WM) is calibrated.

4. The mobile radio transceiver device (SE) as
5 claimed in one of the preceding claims, characterized
in that

- a) the antenna (ANT) is a telescopic antenna (ANT1)
to which an electrically non-conductive wire (D1)
is attached on the inside at the antenna point,
- 10 b) the adjusting means (VM) exhibit an electrically
non-conductive coil former (SP1) on which the
electrically non-conductive wire (D1) is wound,
- c) the electrically non-conductive wire (D1) is of
such a nature that it converts the rotational
15 movement of the coil former (SP1) into a straight-
line movement in order to retract and/or telescope
out the telescopic segments of the telescopic
antenna (ANT1).

20 5. The mobile radio transceiver device (SE) as
claimed in claim 4, characterized in that the
telescopic antenna (ANT1) is equipped, for supporting
the wire (D1) for telescoping out the telescopic
antenna (ANT1), with a spring which presses all
25 telescopic segments of the telescopic antenna (ANT1)
outward so that the telescopic antenna (ANT1) is
completely telescoped out.

6. The mobile radio transceiver device (SE) as
30 claimed in one of claims 1 to 3, characterized in that

- a) the adjusting means (VM) exhibit an electrically
conductive coil former (SP2) on which an
electrically conductive wire (D2), electrically
conductively connected to the coil former (SP2),
35 is wound,

- b) the electrically conductive wire (D2) is of such a nature that it converts a rotational movement of the coil former (SP2) guided by an electrically non-conductive hollow body (H) into a straight-line movement,
- 5

5 c) the antenna (ANT) is constructed as wire antenna (ANT2) which is composed of the telescoped-out wire (D2) and the electrically conductively connected coil former (SP2), a connection of the wire antenna (ANT2) being achieved via an electrically conductive sliding contact (SK) which contacts the coil former (SP2) at the base.

10 7. The mobile radio transceiver device (SE) as claimed in one of claims 1 to 3, characterized in that

15 a) the adjusting means (VM) exhibit an electrically conductive coil former (SP2) on which an electrically conductive wire (D2), electrically conductively connected to the coil former (SP2), is wound,

20 b) the electrically conductive wire (D2) is of such a nature that it converts a rotational movement of the coil former (SP2) guided by an electrically non-conductive hollow body (H) into a straight-line movement,

25 c) the antenna (ANT) is constructed as wire antenna (ANT2) which is composed of the telescoped-out wire (D2) and the electrically conductively connected coil former (SP2), a connection of the wire antenna (ANT2) being achieved via an electrically conductive sliding contact (SK) which contacts the wire (D2) wound onto the coil former (SP2) at the base.

30 8. The mobile radio transceiver device (SE) as claimed in one of the preceding claims, characterized in that the adjusting device (VM) is an electric motor.

35 9. The mobile radio transceiver device (SE) as claimed in claim 8, characterized in that the electric motor is a stepping motor.

10. The mobile radio transceiver device (SE) as claimed in one of the preceding claims, characterized in that the control unit (μP) is a processor with software designed for generating the control signal (U_{ST}) or, respectively, the control signals (U_{ST}).

11. The mobile radio transceiver device (SE) as claimed in one of claims 1 to 9, characterized in that the control unit (μP) is constructed as switchgear.

10

12. The mobile radio transceiver device (SE) as claimed in claim 4, characterized in that the electrically non-conductive wire (D1) is constructed as a nylon wire.

Abstract

Mobile radio transceiver device with tuneable antenna

To implement a transmitting/receiving capability in different frequency ranges by means of radio transceiver devices SE which guarantee a uniformly stable antenna gain, the radio transceiver devices SE are equipped with an antenna ANT, the length l_{ANT} of which is adjustable, the antenna length l_{ANT} being changed by means of adjusting means VM controlled by means of a control device μP . The control device μP controls the adjusting means VM in dependence on physical input variables EG representing the antenna length l_{ANT} until the antenna length l_{ANT} corresponds to one quarter of the wavelength λ .

FIGURE 3

000054-102401
104201-166600

FIG. 1

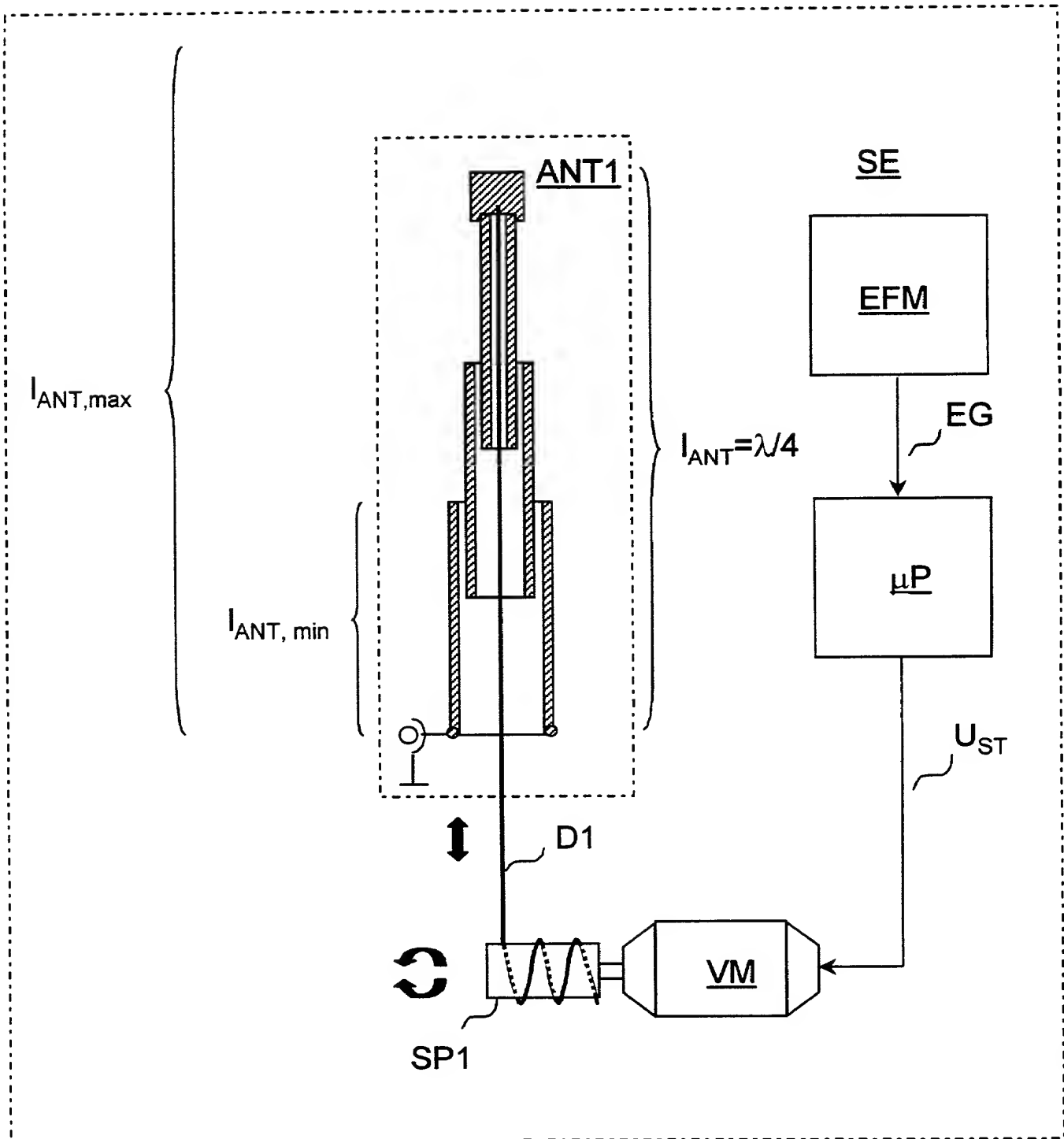


FIG 1

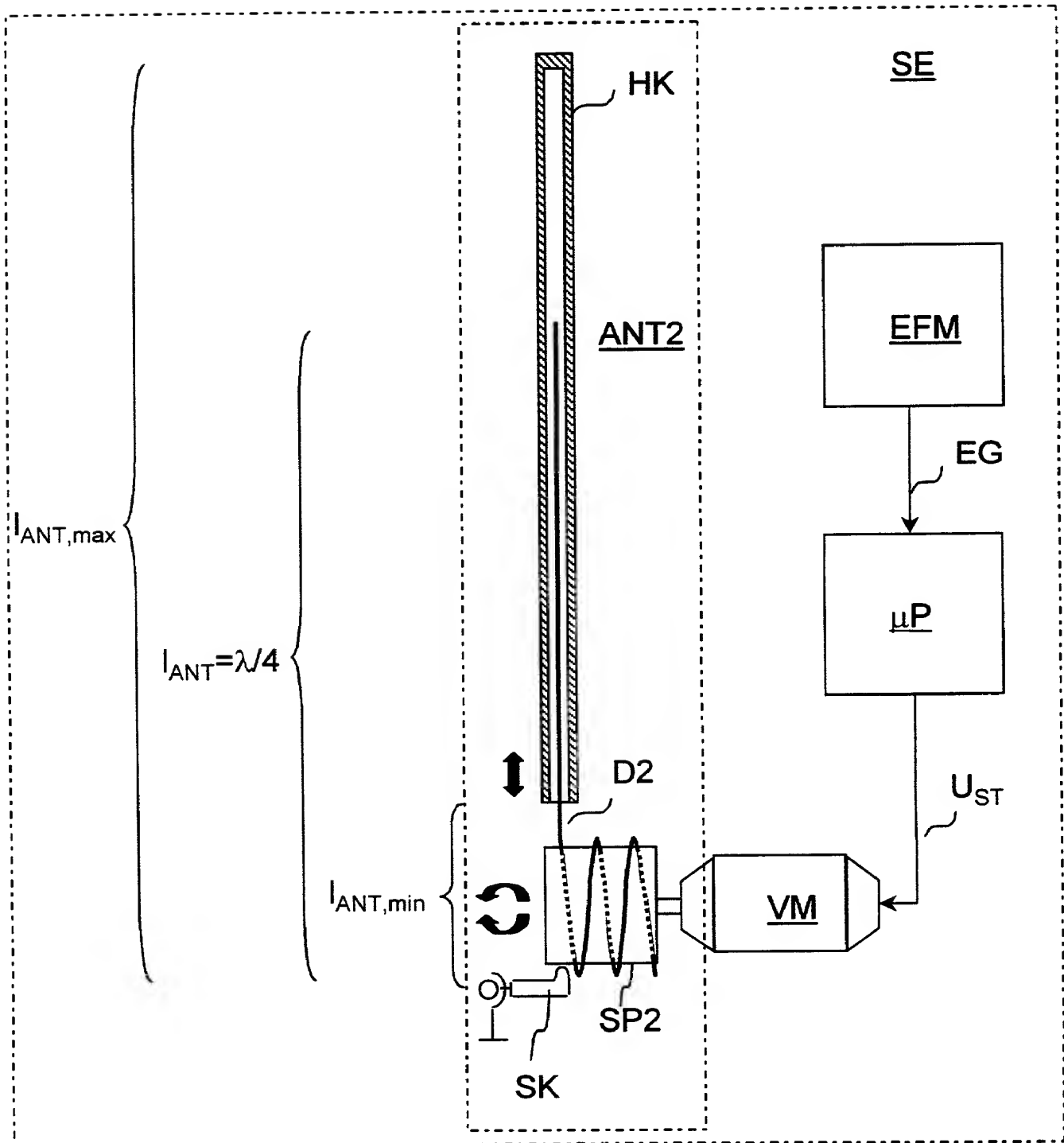


FIG 2

Pub. No. 1130550

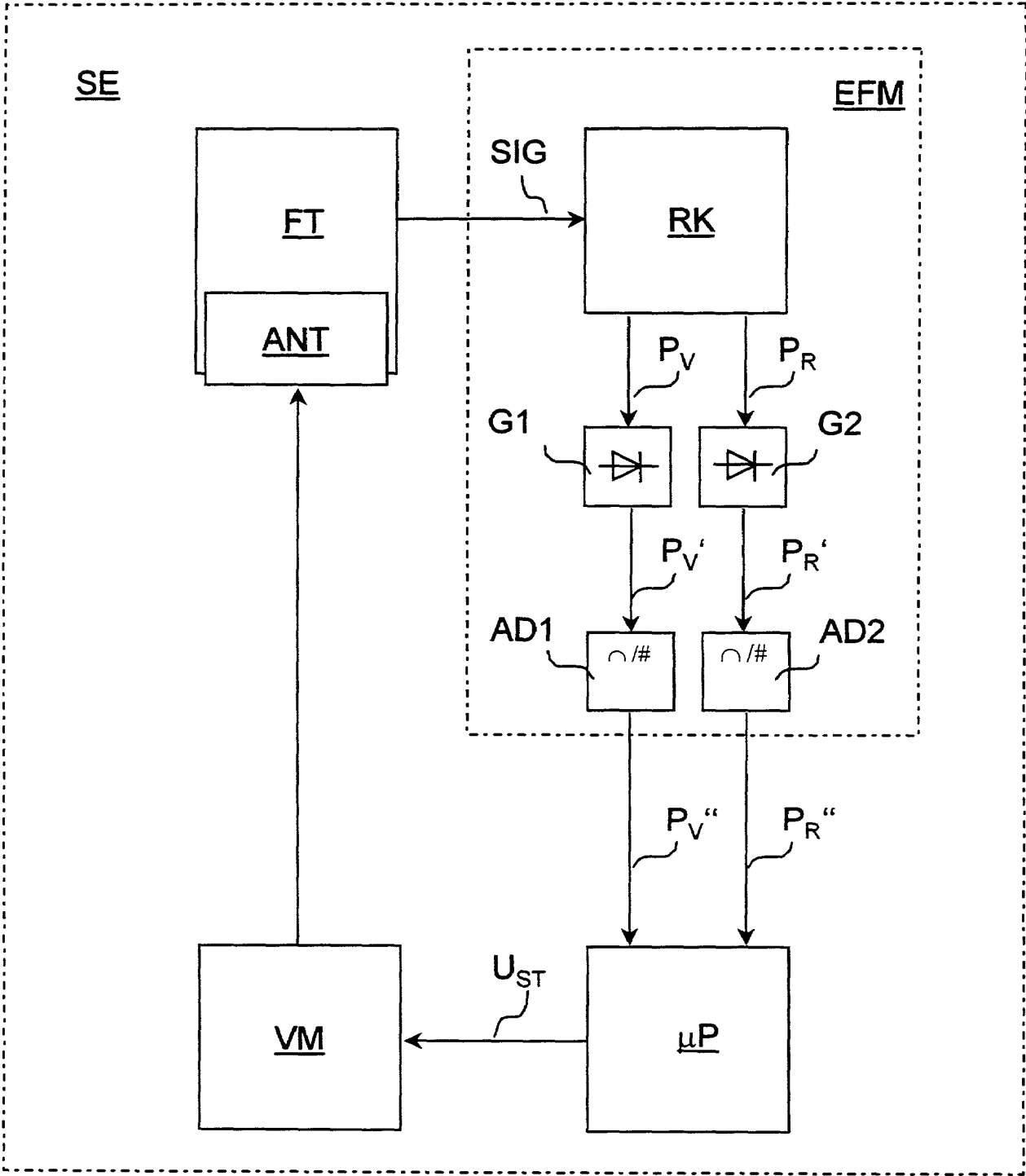


FIG 3

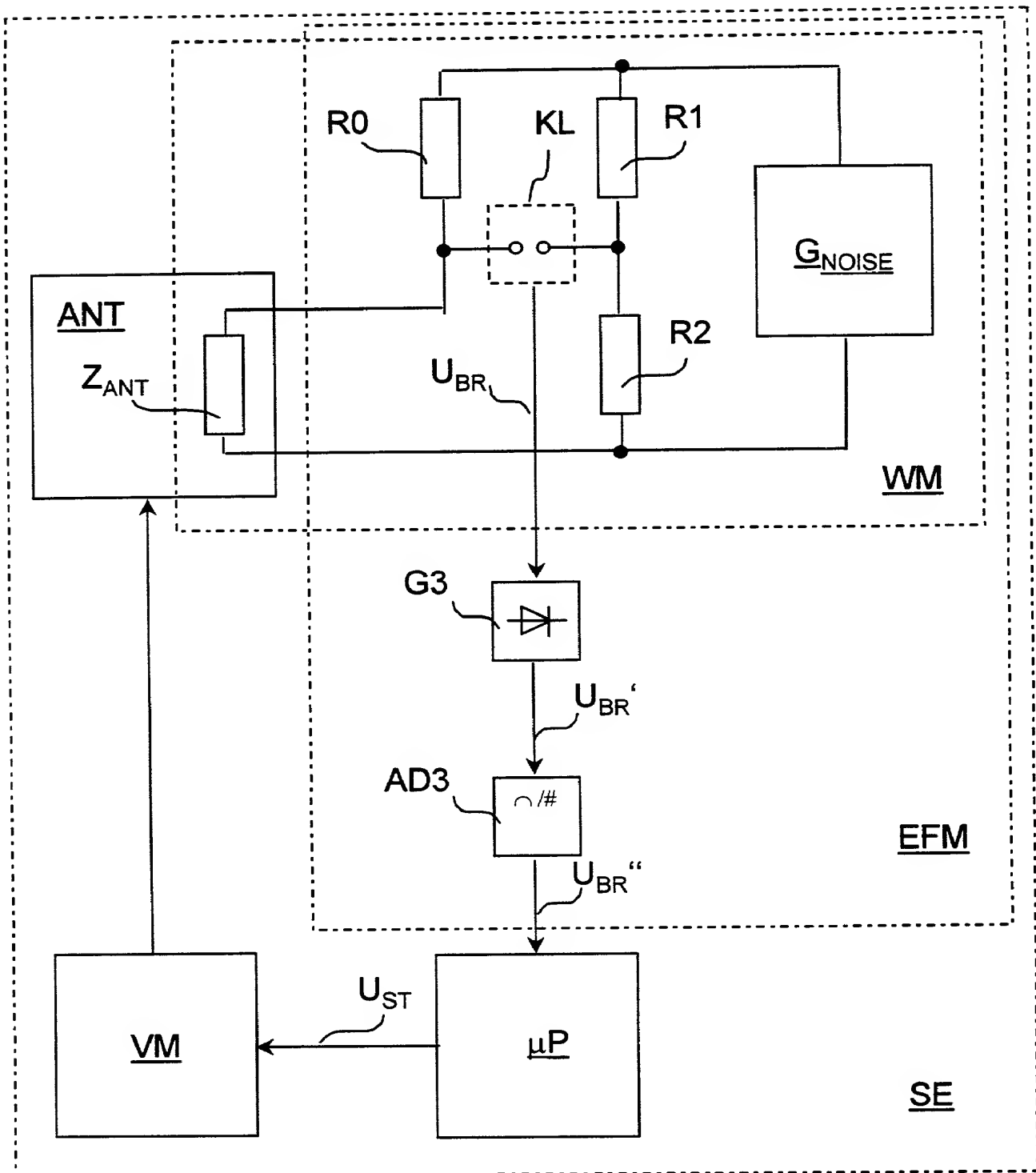


FIG 4

IDNR: 2590 / V: 99-1.00 / B:Val

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19919107.7

DE

27.04.1999

☒

☐

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

Yes
Ja

No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐
Yes
Ja

☐
No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐
Yes
Ja

☐
No
Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/01248

(Application Serial No.)
(Anmeldeseriennummer)

20.04.2000

(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

anhängig

(Status)
(patentiert, anhängig,
aufgegeben)

pending

(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date D,M,Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden können, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: (Name und Registrationsnummer anführen)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)



29177

And I hereby appoint
PATENT & TRADEMARK OFFICE

Customer No.

Telefongespräche bitte richten an:
(Name und Telefonnummer)

Direct Telephone Calls to: (name and telephone number)

Ext. _____

Postanschrift:

Send Correspondence to:

Bell, Boyd & Lloyd LLC
Three First National Plaza, 70 West Madison Street, Suite 3300 60602-4207 Chicago, Illinois
Telephone: (001) 312 372 11 21 and Facsimile (001) 312 372 20 98

or

Customer No. 29177

Voller Name des einzigen oder ursprünglichen Erfinders: VOLKER DETERING	Full name of sole or first inventor: VOLKER DETERING
Unterschrift des Erfinders: <i>Volker Detering</i>	Inventor's signature
Datum: 07.01.01	Date
Wohnsitz: EMMERICH, DEUTSCHLAND	Residence: EMMERICH, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: GROENDAHLSCHER WEG 20	Post Office Address: GROENDAHLSCHER WEG 20
46446 EMMERICH	46446 EMMERICH
Voller Name des zweiten Miterfinders (falls zutreffend): DIETMAR GAPSKI	Full name of second joint inventor, if any: DIETMAR GAPSKI
Unterschrift des Erfinders: <i>Dietmar Gapski</i>	Second inventor's signature
Datum: 30.9.2001	Date
Wohnsitz: BOCHOLT, DEUTSCHLAND	Residence: BOCHOLT, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: IM OSTERESCH 25	Post Office Address: IM OSTERESCH 25
46397 BOCHOLT	46397 BOCHOLT

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

000001102401